KEEPING WATCH FOR "LEAST WANTED" INVADERS

Biological invasions of marine habitats, and particularly estuaries, are occurring at an accelerating rate. The ecological threats posed by some alien species rival those of pollution or anthropogenic habitat destruction, and are among the greatest resource management challenges for estuarine ecosystems. Once widespread and abundant, aquatic invaders are extremely difficult, if not impossible to eradicate. However, if they are detected soon after initial establishment, removal efforts can be successful. Such management depends on early detection of new invasions within this window of opportunity.

The Elkhorn Slough National Estuarine Research Reserve, in partnership with the Elkhorn Slough Foundation and the Monterey Bay National Marine Sanctuary and with funding from California Sea Grant, has recently launched an early detection program for aquatic alien invaders. The goal of this new program is to detect new invasions of problematic non-native aquatic organisms early enough to allow for successful eradication.

"Alien", "non-indigenous", "non-native", or "introduced" species are those moved far beyond their natural ranges by human activities. Aquatic species are transported between bioregions by activities such as commercial shipping and oyster culturing, and can spread within a region due to local boat traffic and dispersal of larvae on currents. Aquatic invasions have been extremely common in recent decades, and are continuing at a rapid pace. Estuaries are particularly highly invaded; those with big ports often have hundreds of non-native species established in them. Many non-native species may have relatively minor influences on the communities they invade. Some, however, have dramatic negative impacts. Our early detection program focuses on such species, whose negative effects have been demonstrated elsewhere. These non-native species may have impacts at a variety of scales. Invaders have been shown to cause local extinction of native competitors or prey organisms, alteration of community composition or food webs, change in physical habitat structure, and even alteration of energy or material flux through whole ecosystems.

What can be done about aquatic invasions? On the one hand, prevention of further invasions is critical. Public support for regulatory measures decreasing human transport of invasive propagules will help prevent invasions. On the other hand, control of existing invasions is sometimes possible. Once a non-native aquatic species has become abundant and widespread, it is difficult or impossible to control it. However, there is a window of opportunity soon after invasion when eradication efforts may be successful. In order to intervene during this early establishment phase, early detection of new invasions is essential.

In order to accomplish such early detection during the window of opportunity for eradication, we have developed this new program. We began by assessing existing non-native species composition in the region to establish a baseline, and then chose "least wanted" invaders for the area. From a potential pool of hundreds of known aquatic invaders, we chose a subset of two dozen species that: 1) are not yet present in the Monterey Bay area, 2) have a high potential to be transported there (especially from nearby sources such as San Francisco Bay), 3) are relatively large and easy to identify, and 4) are likely to have a significant ecological impact if they invade.

For example, one invader included is the Northern Pacific Seastar (*Asterias amurensis*), which has invaded Australia and become very abundant, impacting oyster culturing and other native shellfish, which it consumes voraciously. Another species highlighted is the Atlantic Ribbed Mussel (*Ischadium demissum*), blamed with killing and maiming endangered California

Clapper Rails in San Francisco Bay. The Channeled Whelk (*Busycotypus canaliculatus*) was included because is much larger than our native mudflat snails, and has been shown to consume a variety of bivalves in San Francisco Bay.

Each of the two dozen "least wanted" species is described in booklets we have prepared and published. We provide information on diagnostic features for identification, and information on habitat, native origin, invaded areas, and ecological concerns. The booklets also contain instructions on what to do if a putative invader is sighted: individuals are directed to note their exact location, collect a single voucher specimen, and immediately make an "urgent invasive alert" to us. We will then confirm the identification and inform the appropriate agencies (which vary by species and habitat). We will help to coordinate interagency efforts to plan the most appropriate response strategy, and will support rapid response efforts to contain or eradicate the new invasion, if appropriate. The target areas for this early detection program are Elkhorn Slough and Monterey Bay, central California, because the coordinators of this program are based there, because we have good baseline information for these areas and because there are many citizens active in aquatic habitats there. However, we welcome reports from as far south as Morro Bay to as far north as Moss Beach. The success of this program depends on having as many pairs of eyes as possible on the lookout for new aliens. Towards this end, we are attempting to provide booklets to all citizens in the Monterey Bay area who frequent aquatic habitats and are likely to notice alien species. By holding a training workshop and providing free materials, we have involved about 50 regional coastal organizations (kayaking, fishing, diving, conservation groups; harbormasters; government agencies; aquaria; universities and research organizations) in this effort, resulting in broad dissemination of nearly 4000 booklets to their constituents. If you represent a coastal organization that would be interested in participating in this program, contact us (research@elkhornslough.org) to receive a free shipment of booklets, flyers, and a CD providing background on aquatic invasions. You can also download a copy of the booklet as a PDF from www.elkhornslough.org/invader.

By involving the community in this effort to look for and report new invasions of "least wanted" species, we are increasing the likelihood of detecting new invasions in time to take action. Familiarize yourself with these unwanted aliens, and help us to better protect the rich native coastal biodiversity of central California!

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The two dozen least wanted alien species for the Monterey Bay region.

GROUP	LEAST WANTED SPECIES	COMMON NAME
Algae	*Caulerpa taxifolia*	Caulerpa
	Undaria pinnatifida	Wakame
Plants	*Spartina alterniflora*	Smooth Cordgrass
Invertebrates	*Phyllorhiza punctata*	Spotted Jellyfish
	Maeotias inexspectata	Black Sea Jellyfish
	Sabella spallanzanii	Mediterranean Fan Worm
	Balanus amphitrite	Striped Barnacle
	Procambarus clarkii	Red Swamp Crayfish
	Homarus americanus	American Lobster
	Eriocheir sinensis	Chinese Mitten Crab
	Rhithropanopeus harrisii	Harris Mud Crab
	Ilyanassa obsoleta	Eastern Mud Snail
	Busycotypus canaliculatus	Channeled Whelk
	Rapana venosa	Veined Rapa Whelk
	Ischadium demissum	Atlantic Ribbed Mussel
	Perna spp.	Green Mussel
	Mercenaria mercenaria	Northern Quahog
	Petricolaria pholadiformis	False Angelwing
	Pteria sterna	Winged Oyster
	Potamocorbula amurensis	Asian Clam
	Asterias amurensis	Northern Pacific Seastar
	Zoobotryon verticillatum	Spaghetti Bryozoan
Vertebrates	*Tridentiger trigonocephalus*	Chameleon Goby
	Malaclemys terrapin	Diamondback Terrapin